

REMARKS

Claims 31-65 are currently pending in this application. Claims 31-65 are currently rejected. Applicants are herewith amending Claims 31, 32, 56, 60, and 61.

Claim 31 has been amended to clarify that the metal alloy is directed into at least two intersecting inner channels. Support for the amendment can be found in the Application as originally filed, for example, at page 5, lines 21-29; at page 12, lines 3-11, and in Examples 1 and 2.

Claim 32 has been amended to correct an inadvertent typographical error, “steams” has been corrected to “streams,” and also has been amended to further clarify that streams of the same superheated alloy composition flow from the first inner channel and the second inner channel. Support for the amendments can be found in the Application as originally filed, for example, at page 5, lines 21-29; at page 12, lines 3-11, and in Examples 1 and 2.

Claim 56 has been amended to correct an inadvertent typographical error, “steams” has been corrected to “streams,” and has been amended to state that the superheated metal alloy is directed into both the first melt inlet and the second melt inlet of the nucleation reactor. Support for the amendment can be found in the Application as originally filed, for example, at page 5, lines 21-29; at page 12, lines 3-11, and in Examples 1 and 2.

Claim 60 has been amended to claim a method for forming a semi-solid metal alloy, comprising directing a metal alloy, heated above the liquidus temperature of the metal alloy, into a nucleation reactor, the nucleation reactor having a plurality of intersecting inner channels such that the metal alloy is streamed into at least two intersecting inner channels; impinging streams of the metal alloy directed into the at least two intersecting inner channels at an intersection thereof; cooling the metal alloy within the nucleation reactor to a temperature between a solidus temperature and a liquidus temperature of the metal alloy to thereby form a plurality of nuclei, thereby forming a nucleated alloy; and passively mixing the nucleated alloy at a temperature between the solidus temperature and the liquidus temperature of the nucleated alloy, without raising the temperature of the alloy stream to thereby prevent the nuclei from melting, thereby forming the semi-solid metal alloy. Support for the amendments can be found in the Application

as originally filed, for example, at page 5, lines 21-29; at page 12, lines 3-11, and in Examples 1 and 2.

Claim 61 has been amended to clarify that a first stream of the alloy flows through the first inner channel and a second stream of the same alloy flows through the second inner channel. Support for the amendments can be found in the Application as originally filed, for example, at page 5, lines 21-29; at page 12, lines 3-11, and in Examples 1 and 2.

Reply to Rejection of Claims 31-42, 44-49, 52-57, 60, 61, and 64-65

Claims 31-42, 44-49, 52-57, 60, 61, and 64-65 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over European Patent Application No. EP 0 745 694 by Adachi, *et al.* (hereinafter, “Adachi, *et al.*”). The Examiner acknowledges that Adachi, *et al.* does not teach a plurality of intersecting channels as in the (b) steps or mixing via fluid impingement and convection as in the (c) and (e) steps of those previously presented claims. The Examiner also states that, regarding the (c) steps, Adachi, *et al.* teaches that two or more liquid alloys having different melting points are heated and then mixed either directly within an insulated vessel or along a trough in a channel into an insulated vessel.

As described above, Applicants have amended independent Claims 31, 56, and 60. Claim 31, as amended, states “... a. superheating a metal alloy ...b. directing the superheated metal alloy into a nucleation reactor having a plurality of intersecting inner channels such that the metal alloy is directed into at least two intersecting inner channels; [and] c. passively mixing the superheated metal alloy ...” (emphasis added).

Adachi, *et al.* does not teach or suggest directing a metal alloy into at least two intersecting inner channels, as in amended Claim 31. While Adachi, *et al.* appears to disclose mixing two or more liquid alloys having different melting points, Adachi, *et al.* does not teach or suggest directing the same superheated metal alloy composition into at least two intersecting inner channels and passively mixing the superheated metal alloy. (See Adachi, *et al.* at page 48, line 4 through page 49, line 42.) One of ordinary skill in the art would not have been motivated to apply the disclosure of Adachi, *et al.*, wherein mixing is used to combine alloys of different melting points, to arrive at the presently claimed invention wherein a superheated metal alloy composition is directed into at least two intersecting inner channels and passively mixed via fluid

impingement and convection within a nucleation reactor. Adachi, *et al.* does not teach or suggest any motivation to impinge streams of the same alloy within a nucleation reactor.

Adachi, *et al.* also does not teach or suggest the advantages that can be gained by practicing the claimed invention. For example, Adachi, *et al.* does not teach or suggest a method wherein a nucleated alloy stream is continuously mixed to distribute nuclei throughout the stream and thereby continuously forming an alloy substantially free of dendrites as in the presently claimed invention. (See, e.g., Specification at page 5, lines 21-29.) The claimed invention also can provide continuous processes for producing semi-solid metal slurries which allow semi-solid metal slurries to be used in a much broader range of applications and can relax the size and shape limitations imposed by the use of batch processes, such as the batch and semi-continuous processes disclosed by Adachi, *et al.* (which requires that the alloy be held in an insulated vessel for a period of time, see Adachi, *et al.* Abstract). (See, e.g., Specification at page 7, lines 8-11.)

Thus, Adachi, *et al.* does not teach or suggest the subject matter of amended Claim 31.

Likewise, Adachi, *et al.* does not teach or suggest directing a superheated metal alloy into a first melt inlet and a second melt inlet of a nucleation reactor wherein streams of the alloy flow through a first inner channel and a second inner channel and passively mix via fluid impingement and convection, as described in amended Claim 56. Again, one of ordinary skill in the art would not have been motivated to apply the disclosure of Adachi, *et al.*, wherein mixing is used to combine alloys of different melting points, to arrive at the presently claimed invention wherein streams of the same alloy flow through a first inner channel and a second inner channel and passively mix via fluid impingement and convection. Adachi, *et al.* does not teach or suggest any motivation to impinge streams of the same alloy within a nucleation reactor.

Adachi, *et al.* also does not teach or suggest the method of amended Claim 60. For example, Adachi, *et al.* does not teach or suggest directing a metal alloy, heated above the liquidus temperature of the metal alloy, into a nucleation reactor, the nucleation reactor having a plurality of intersecting inner channels such that the metal alloy is streamed into at least two intersecting inner channels and impinging streams of the metal alloy directed into the at least two intersecting inner channels, as in amended Claim 60. Again, one of ordinary skill in the art would not have been motivated to apply the disclosure of Adachi, *et al.*, wherein mixing is used

to combine alloys of different melting points, to arrive at the presently claimed invention which includes impinging streams of the same metal alloy composition. Adachi, *et al.* does not teach or suggest any motivation to impinge streams of the same alloy within a nucleation reactor.

Thus, Adachi, *et al.* also does not teach or suggest the subject matter of amended Claims 56 and 60.

Claims 32-42, 44-49, 52-55, 57, 61, and 64-65 are variously dependent upon independent Claims 31, 56, and 60. Since independent Claims 31, 56, and 60 are patentable over Adachi, *et al.*, claims dependent upon those independent claims are also patentable.

Thus, the claimed invention is not suggested by Adachi, *et al.* and Applicants request withdrawal of the Examiner's rejection of Claims 31-42, 44-49, 52-57, 60, 61, and 64-65 under 35 U.S.C. § 103.

Reply to Rejection of Claims 43, 50, and 51

Claims 43, 50, and 51 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Adachi, *et al.* variously in view of "Efficient Formation of Structure Suitable for Semi-Solid Forming" by Martinez, *et al.* (hereinafter, "Martinez, *et al.*"); U.S. Patent No. 6,742,567 issued to Winterbottom, *et al.* (hereinafter, "Winterbottom, *et al.*"); or U.S. Patent No. 6,908,590 issued to DasGupta (hereinafter, "DasGupta").

As described above, Adachi, *et al.* does not teach or suggest directing the same superheated metal alloy composition into at least two intersecting inner channels and passively mixing the superheated metal alloy as in amended independent Claim 31, upon which Claims 43, 50, and 51 are dependent. Neither Martinez, *et al.*, Winterbottom, *et al.*, nor DasGupta remedy this deficiency of Adachi, *et al.* For example, Martinez, *et al.* does not teach or suggest directing the same superheated metal alloy composition into at least two intersecting inner channels and passively mixing the superheated metal alloy. Instead of passive mixing, Martinez, *et al.* discloses actively mixing a slurry by stirring with a rotating rod. Also, neither Winterbottom, *et al.* nor DasGupta teach or suggest directing the same superheated metal alloy composition into at least two intersecting inner channels and passively mixing the superheated metal alloy.

Thus, the claimed invention is not suggested by Adachi, *et al.* in combination with Martinez, *et al.*, Winterbottom, *et al.*, or DasGupta, and Applicants request withdrawal of the Examiner's rejection of Claims 43, 50, and 51 under 35 U.S.C. § 103.

Reply to Rejection of Claims 58-59 and 62-63

Claims 58-59 and 62-63 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Adachi, *et al.* in view of U.S. Patent No. 5,520,460 issued to Lantz (hereinafter, "Lantz"). The Examiner states that using a plurality of intersecting channels to perform mixing is a well-known technique in the art which is evidenced by Lantz.

Lantz discloses a static mixing element. Lantz does not teach or suggest that such a static mixing element can be used for mixing a superheated metal alloy or that such a mixing element would provide suitable results in forming a semi-solid metal alloy. Further, Adachi, *et al.* does not teach or suggest the use of such an apparatus for mixing a superheated metal alloy. Accordingly, one of ordinary skill in the art would not have been motivated to combine the teachings of Lantz with the teachings of Adachi, *et al.* and the combination of references is improper.

Further, even if one were to have combined the disclosures of the cited references, the presently claimed invention would not have resulted. For example, Adachi, *et al.* does not teach or suggest directing a superheated metal alloy into a first melt inlet and a second melt inlet of a nucleation reactor wherein streams of the alloy flow through a first inner channel and a second inner channel and passively mix via fluid impingement and convection, as described in amended Claim 56 from which Claims 58 and 59 depend. Adachi, *et al.* also does not teach or suggest directing a metal alloy, heated above the liquidus temperature of the metal alloy, into a nucleation reactor, the nucleation reactor having a plurality of intersecting inner channels such that the metal alloy is streamed into at least two intersecting inner channels and impinging streams of the metal alloy directed into the at least two intersecting inner channels, as described in amended Claim 60 from which Claims 62 and 63 depend. Lantz does not remedy these deficiencies of Adachi, *et al.*


Thus, the claimed invention is not suggested by Adachi, *et al.* in combination with Lantz, and Applicants request withdrawal of the Examiner's rejection of Claims 58-59 and 62-63 under U.S.C. § 103.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner believes that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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